CLAIMS

The invention claimed is:

1. A method of converting a reticle from a first configuration suitable for attenuation and approximately 180° phase-shifting of a later generation (shorter wavelength) photolithography radiation to a second configuration suitable for attenuation and approximately 180° phase-shifting of an earlier generation (longer wavelength) photolithography radiation comprising reducing a thickness of a portion of a substantially radiation-transmissive substrate of the reticle.

2. The method of claim 1 wherein the attenuation of the later generation photolithography radiation by the first configuration of the reticle is at least about 90%, and wherein the attenuation of the earlier generation photolithography radiation by the second configuration of the reticle is from about 50% to less than about 90%.

3. The method of claim 1 wherein the substrate comprises quartz.

4. The method of claim 3 wherein the reducing the thickness of the portion of the quartz-comprising substrate utilizes a dry etch.

5. The method of claim 3 wherein the first configuration of the reticle comprises a patterned radiation-attenuating layer over the quartz-comprising substrate, wherein the radiation-attenuating layer has an elevational thickness over the quartz-comprising substrate, and wherein the elevational thickness of the radiation-attenuating layer is not altered in converting the reticle from the first configuration to the second configuration.

6. The method of claim 5 wherein the radiation-attenuating layer consists essentially of molybdenum and silicon.

7. The method of claim 5 wherein the radiation-attenuating layer consists essentially of titanium and nitrogen.

8. The method of claim 5 wherein the radiation-attenuating layer consists essentially of zirconium and oxygen.

9. The method of claim 5 wherein the radiation-attenuating layer consists essentially of silicon, nitrogen and oxygen.

10. The method of claim 5 wherein the radiation-attenuating layer consists essentially of tantalum and hafnium.

11. The method of claim 1 wherein the later generation photolithography radiation is 157 nanometer wavelength and wherein the earlier generation photolithography radiation is a 193 nanometer wavelength.

12. The method of claim 1 wherein the later generation photolithography radiation is 157 nanometer wavelength and wherein the earlier generation photolithography is 248 nanometer wavelength.

13. The method of claim 1 wherein the later generation photolithography radiation is 157 nanometer wavelength and wherein the earlier generation photolithography radiation is 365 nanometer wavelength.

14. The method of claim 1 wherein the later generation photolithography radiation is 193 nanometer wavelength and wherein the earlier generation photolithography radiation is 248 nanometer wavelength.

15. The method of claim 1 wherein the later generation photolithography radiation is 193 nanometer wavelength and wherein the earlier generation photolithography radiation is 365 nanometer wavelength.

16. The method of claim 1 wherein the later generation photolithography radiation is 248 nanometer wavelength and wherein the earlier generation photolithography radiation is 365 nanometer wavelength.

17. A method of converting a reticle from a first configuration suitable for a shorter wavelength of radiation to a second configuration suitable for a longer wavelength of radiation, comprising:

providing the reticle in the first configuration suitable for the shorter wavelength of radiation, the first configuration reticle comprising a substrate material and a patterned material over the substrate material, the patterned material overlapping first regions of the substrate material and not overlapping second regions of the substrate material, the patterned material having a lower absolute transmission of the shorter wavelength of radiation than the substrate material, the shorter wavelength of radiation being shifted substantially out of phase upon passing through the combined thicknesses of the patterned material and first regions of the substrate material relative to passing through the thickness of the second regions of the substrate material; and

while protecting the first regions of the substrate with at least the patterned material, reducing the thickness of the second regions of the substrate material; after the reduction in thickness, the longer wavelength of radiation being shifted substantially out of phase upon passing through the combined thicknesses of the patterned material and first regions of the substrate material relative to passing through the thickness of the second regions of the substrate.

18. The method of claim 17 wherein the substrate material comprises quartz and wherein the reduction of the thickness of the second regions of the substrate material comprises a dry etch.

19. The method of claim 17 wherein a layer comprising chromium is over the patterned material during the reduction of the thickness of the second regions of the substrate material; and wherein the layer comprising chromium is removed from over at least some of the patterned material after the reduction of the thickness of the second material.

20. The method of claim 17 wherein the second configuration of the reticle shifts the phase of the longer wavelength of radiation by from about 170° to about 190° as the radiation passes through the combined thicknesses of the patterned material and first regions of the substrate material relative to when the radiation passes through the thickness of the second regions of the substrate.

21. The method of claim 17 wherein the second configuration of the reticle shifts the phase of the longer wavelength of radiation by from about 175° to about 185° as the radiation passes through the combined thicknesses of the patterned material and first regions of the substrate material relative to when the radiation passes through the thickness of the second regions of the substrate.

22. The method of claim 17 wherein the second configuration of the reticle shifts the phase of the longer wavelength of radiation by 184° ± 5° as the radiation passes through the combined thicknesses of the patterned material and first regions of the substrate material relative to when the radiation passes through the thickness of the second regions of the substrate.

23. The method of claim 17 wherein the patterned material has an absolute transmission of the longer wavelength of radiation of from about 1% to about 50%.

24. The method of claim 17 wherein the patterned material has an absolute transmission of the longer wavelength of radiation of from about 8% to about 40%.

25. The method of claim 17 wherein the patterned material has an absolute transmission of the longer wavelength of radiation of from about 20% to about 40%.

26. The method of claim 17 wherein the patterned material has an absolute transmission of the longer wavelength of radiation of about 28%.

27. The method of claim 17 wherein the patterned material has a higher absolute transmission of the longer wavelength of radiation than of the shorter wavelength of radiation.

28. The method of claim 17 wherein the patterned material comprises one or more of TiN, ZrO, SiON, TaHf and MoSi; with the compositions being shown in terms of the elements contained therein rather than in terms of a particular stoichiometry of the elements.

29. The method of claim 17 wherein the patterned material consists essentially of molybdenum and silicon.

30. The method of claim 17 wherein the first configuration of the reticle comprises the first and second regions of the substrate at about the same thickness as one another.

31. The method of claim 17 wherein the shorter wavelength of radiation is about 157 nanometers and the longer wavelength of radiation is about 193 nanometers.

32. The method of claim 17 wherein the shorter wavelength of radiation is about 157 nanometers and the longer wavelength of radiation is about 248 nanometers.

33. The method of claim 17 wherein the shorter wavelength of radiation is about 157 nanometers and the longer wavelength of radiation is about 365 nanometers.

34. The method of claim 17 wherein the shorter wavelength of radiation is about 193 nanometers and the longer wavelength of radiation is about 248 nanometers.

35. The method of claim 17 wherein the shorter wavelength of radiation is about 193 nanometers and the longer wavelength of radiation is about 365 nanometers.

36. The method of claim 17 wherein the shorter wavelength of radiation is about 248 nanometers and the longer wavelength of radiation is about 365 nanometers.

37. A method of forming a reticle, comprising:

providing a reticle template, the reticle template comprising a base and a patterned material over the base, the patterned material overlapping first regions of the base and not overlapping second regions of the base, the reticle template being configured to pattern a first radiation which is 157 nm radiation, 193 nm radiation or 248 nm radiation; a phase of the first radiation being shifted by about 180° as the radiation passes through the combined thicknesses of the patterned material and first regions of the base relative to when the radiation passes through the thickness of the second regions of the base; and

reducing the thickness of the second regions of the base; the reticle template being configured to pattern a second radiation after the reduction in thickness; the second radiation being different from the first radiation and being 193 nm radiation, 248 nm radiation or 365 nm radiation; after the reduction in thickness of the second regions, the second radiation being shifted substantially out of phase upon passing through the combined thicknesses of the patterned material and first regions of the base relative to passing through the second regions of the base.

38. The method of claim 37 wherein the base comprises quartz.

39. The method of claim 37 wherein the first radiation is 157 nanometers and the second radiation is 193 nanometers.

40. The method of claim 37 wherein the first radiation is 157 nanometers and the second radiation is 248 nanometers.

41. The method of claim 37 wherein the first radiation is 157 nanometers and the second radiation is 365 nanometers.

42. The method of claim 37 wherein the first radiation is 193 nanometers and the second radiation is 248 nanometers.

43. The method of claim 37 wherein the first radiation is 193 nanometers and the second radiation is 365 nanometers.

44. The method of claim 37 wherein the first radiation is 248 nanometers and the second radiation is 365 nanometers.

45. A method of converting a reticle from a first configuration suitable for 193 nm wavelength radiation to a second configuration suitable for 248 nm wavelength radiation, comprising:

providing the reticle in the first configuration, the first configuration reticle including a quartz-containing material and a patterned layer consisting essentially of molybdenum and silicon over the quartz-containing material, the patterned layer overlapping first regions of the quartz-containing material and not overlapping second regions of the quartz-containing material, a phase of 193 nm wavelength radiation being shifted by about 180° as the radiation passes through the combined thicknesses of the patterned layer and first regions of the quartz-containing material relative to when the radiation passes through the thickness of the second regions of the quartz-containing material; and

while protecting the first regions of the quartz-containing material with at least the patterned layer, etching the second regions of the quartz-containing material with a dry etch to convert the reticle to the second configuration.

46. The method of claim 45 wherein a layer comprising chromium is over the patterned layer during the etching of the second regions of the quartz-containing material; and wherein the layer comprising chromium is removed from over at least some of the patterned layer after the etching of the second regions of the quartz-containing material.

47. The method of claim 45 wherein the second configuration of the reticle shifts a phase of 248 nm wavelength radiation by about 180° ± about 10° as the radiation passes through the combined thicknesses of the patterned layer and first regions of the quartz-containing material relative to when the radiation passes through the thickness of the second regions of the quartz-containing material.

48. The method of claim 45 wherein the second configuration of the reticle shifts a phase of 248 nm wavelength radiation by about 180° ± about 5° as the radiation passes through the combined thicknesses of the patterned layer and first regions of the quartz-containing material relative to when the radiation passes through the thickness of the second regions of the quartz-containing material.

49. The method of claim 45 wherein the second configuration of the reticle shifts a phase of 248 nm wavelength radiation by about 184° ± about 5° as the radiation passes through the combined thicknesses of the patterned layer and first regions of the quartz-containing material relative to when the radiation passes through the thickness of the second regions of the quartz-containing material.

50. The method of claim 45 wherein the dry etch utilizes C_2F_6.

51. The method of claim 45 wherein first configuration of the reticle comprises a thickness of first regions of the quartz-containing material which is about the same as the thickness of the second regions of the quartz-containing material, and which is about 250 mils; and wherein the etching reduces a thickness of the second regions of the quartz-containing material by about 600Å.